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Davor Löffler, John J. McGraw † and

Niels N. Johannsen |

Weapons in and as History: On the Ontogenerative Function of Materialized Preemption and Intelligence in Weapons Technology

In memoriam John J. McGraw, great scholar and friend

Bionote: Davor Löffler is a lecturer in history of knowledge and epistemology at Leuphana University, Lüneburg, Germany, and a teacher at the interdisciplinary research platform The New Centre for Research and Practice. He earned his PhD in Sociology from Free University of Berlin with an interdisciplinary thesis on the shift of social structures, cognition and temporality in the Technological Civilization. Previously he worked as lecturer in Sociology and Philosophy at the BTK University of Art and Design, Berlin, and collaborated in various interdisciplinary working groups such as the Mind Machine Project at the MIT, Cambridge, Massachusetts, USA, the Interacting Minds Center, Aarhus, Denmark, and the Role of Culture in Early Expansions of Humans Group at the Institute of Prehistory, Tübingen, Germany. He is author and editor in the field of cultural theory and philosophical anthropology.

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Bionote: John J. McGraw (1974-2016) was an anthropologist who worked in Latin America and studied material and cognitive aspects of rituals, religion and social interaction. He did long-term field work in the Guatemalan highlands and was intensely interested in divination, knowledge, decision-making and joint action as well as long-term trajectories in the interaction of technology, cognition and social organization in human evolution and history. At the time of his much too early passing, John was an Assistant Professor at California State University, Northridge.

Bionote: Niels N. Johannsen is an Associate Professor at the Department of Archaeology and Heritage Studies and the Interacting Minds Centre at Aarhus University, Denmark. He received his degrees from Aarhus and Cambridge, with research stays in Edinburgh and Oxford, focusing on environmental and cognitive archaeology, the Neolithic of Europe and the relationship between technological and wider cultural change. He is particularly interested in interdisciplinary research efforts - understanding the epistemological and cultural prerequisites of such collaborations and making them work in practice. His current research includes collaborative projects involving palaeogenetics, geoscience, physics and experimental cognitive science.

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Abstract: Weapons technology is a key factor contributing to cultural evolution because it enables humans actively to protect themselves from a variety of natural threats and expand their access to resources. In contrast to non-military technologies, the purpose of which is to subordinate and shape inanimate, non-intentional or trivial, regular states, weapons primarily serve to assert one's own will against self-determined, intentional and non-trivially acting organisms. This functional idiosyncrasy establishes the basis for a continuous arms race, which begins with the need to anticipate phenotypical and mental abilities of animals and other humans through weapons technology before leading to the anticipation of attack and defence capacities of groups and, ultimately, the anticipation of accumulated intelligence and productive accomplishments of entire political states. The dynamics of development in weapons technology prove that weapons are simultaneously an index and a motor of cultural and cognitive evolution. Weapons reflect the organizational and technical capabilities of cultures, indicating special cognitive capacities bound up with the abstract anticipation of enemies as well as the ability to produce mental models of complex adversarial entities. At the same time, weapons relay intercultural and internal selection pressures by playing a decisive role in the processes of general technological and organizational innovation. This innovation also influences the formation of practices, norms, motives and self-images. As such, weapons technology concretizes an integral principle governing cultural evolution and civilizational history.

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Keywords: weapons technology, cultural evolution, cumulative culture, emergence, civilizational history, intelligence, cognitive evolution, preemption, temporality, military history, history of ideas, hominization, coevolution

1. Introduction

In one of the most brilliant transitions in cinematic history, Stanley Kubrick, in his film *2001: A Space Odyssey*, tracks the movement of a tapir femur - depicted in the immediately preceding scenes as humankind's presumptive first weapon - tossed into the sky, whereupon it quickly morphs into an orbiting space station. In this transition, Kubrick compressed 2-3 million years of human evolution, starting with our ancient forebears' first use of tools to the acme of such tool use in the technological conquest of space. A two-fold conceit is implied in this scene, insinuating that, before the advent of tool use, hominids were equal in nature to all other creatures of their time, and, once early hominids began to amplify and extend their bodily powers via technology, they began an ever-accelerating journey that would lead them to escape the boundaries of the Earth itself. This article extends Kubrick's cinematographic compression by arguing that few technological genres have been so central to human evolution, seemingly since the origin of our species, as weaponry.

Although weapons initially likely served to enhance our defence capacities against dangerous animals and to improve hunting abilities, weapons soon became the basic tools for human warfare, surfacing both unforeseeable potential and risk for the species. It is our hypothesis that the dynamics exhibited in the development of weaponry, as well as the larger social and historical processes reciprocally unfolding around these dynamics, represent a fundamental driver of human and social evolution. Even where the pacifist in each of us may seek to eschew this evolutionary precondition (the coevolution of humans and their weaponry), human history is indisputably co-determined by the reciprocal formation of weapon technology and its corresponding mastery of the human body, elaboration of cognitive capacities and organization of society. The significance of weapon technology for cultural evolution here surveyed not only sketches out a historical and evolutionary anthropology of the weapon; much more, it reveals particular cultural evolutionary principles grounding and uniting various threads of a posthumanist and integrative human science. With this paper,[1] we intend to draw focus to and further instigate theoretical and empirical investigation into what seems to be a key, yet somewhat understudied, mechanism in the development of human societies - one that carries profound implications for human culture, well-being and, ultimately, the existence of our (and some other) species.

This article comprises four sections. In the first section, we examine the essential role played by weapons technology in hominization (para. 2). In the next section, we argue for an entangled understanding of the development shared by human capacities and weapons, showing that weapon usage can be understood as both a driver and index of cultural development up to the present (para. 3). Following up on this insight, we show that the key role of weapons in cultural evolution not only lies in the innovations directly brought forth and triggered by the production and usage of weapons, but also in the ineluctable, unintended cultural consequences to which weapon use gives rise (para. 4). Finally, the impact of weapons on cultural evolution and civilizational history is generalized by showing how weapon use reveals and concretizes a developmental principle, which to date has not been identified and made operational within anthropology and cultural evolution theory (para. 5).

2. Weapons Technology as Inaugural Moment in Cultural Evolution

Niche construction and niche expansion based on technology is the main feature and simultaneously the catalyser of human and cultural evolution.[2] While primitive technological achievements such as simple tool use are widespread in the animal kingdom,[3] a new

[1] This article is an updated and extended version of an essay previously published in German. See Niels N. Johannsen, Davor Löffler and John J. McGraw, "Waffengeschichte," in *Entwicklungen der Menschheit. Humanwissenschaften in der Perspektive der Integration*, ed. by Gerd Jüttemann (Lengerich: Pabst, 2014), 191-199. The authors thank Nathan Clendenin for support with the translation and an anonymous reviewer for valuable comments.
[2] Cf. Kevin N. Laland, John Odling-Smee and Marcus W. Feldman, "Niche Construction, Biological Evolution, and Cultural Change," *Behavioral and Brain Sciences*, Vol. 23, No. 1 (2000), 131-175.
[3] Cf. Miriam N. Haidle, *How to Think Tools? A Comparison of Cognitive Aspects in Tool Behavior of Animals and During Human Evolution* (Tübingen: Eberhard Karls Universität Tübingen, 2012). https://publikationen.uni-tuebingen.de/xmlui/handle/10900/49627.

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quality can be seen in the instrumentalization of such achievements by human agency: humans are the only living beings that are able to use tools to produce other tools. Thus, the human capability for "secondary tool use"[4] allows the species actively to develop new abilities, to adapt to new problems and to react flexibly to new evolutionary challenges.

The ability to use the body itself as an instrument is essential for the technological domestication of environments by humans, whereby the body itself is the first and primary tool. Flexible, intentional and teleonomic body instrumentalization is oriented toward and guided by the projection of concepts, causalities and functions into the environment. These instrumental behavioural schemes, based on abstract cues, are developed during moments of reflection and self-affection in acts of experimentation and play. Importantly, they are also adopted through social learning. Once a technology is established by an individual, it can be learned by others through observation and then transmitted intergenerationally, thereby establishing the "ratchet-effect" in cultural evolution and resulting in the exclusively human trait of cumulative culture.[5]

Instrumental behaviour schemes, technological performances and concepts are stored in the traditions, practices, knowledge and artefacts, both cultural and technological, of a given cultural collective. They establish a performative scaffold conducing the "insulation"[6] of cultures and providing the ground for ongoing technological "distantiation"[7] of humans from nature. Technology, cooperation and division of labour, therefore, make up the cultural "membrane"[8] that transmits resources into cultural collectives, protects against natural threats and creates a secure zone around a cultural unit. While culture, as a "second nature,"[9] dampens the evolutionary selection pressure directed at phenotypical adaptations, it simultaneously creates a secondary selection pressure influencing *behavioural* adaptation. Social sanctions convey this pressure, enforcing or weakening instrumental manipulation of environmental states concerning cooperative needs and their contribution to the survival of the collective.

Taming and domestication of the processes in the external natural environment, as well as of the internal natural processes within the body and psyche associated with human niche construction and technology, leads to the expansion of concept-based states of order.[10] This expansion of domesticated and ordered spacetime is based on *two categories of technology*. The first category comprises technologies intended to subordinate and shape inanimate objects, trivially behaving regular processes and environmental states, such as hammers or irrigation systems. In fundamental contrast to this category, the aim of weapons technology is to control and dominate *self-determined*, *intentional* and *non-trivially* acting entities.[11] The weapon, thus, is the medium through which human-based forms of order, concerned with the control of *living* entities, emerge. As such, weapons are of chief importance for processes of hominization and cultural evolution. The breadth of the relationship between hominization and weapon technology is illustrated by the following aspects:

- Weapons mitigate "flight mode" and the constraining effects of certain stressors, resulting, for example, in a surplus of time in which play, experimentation and reflection can flourish. New cognitive, emotional and behavioural resources emancipated by this process may promote encephalization.

- The formation of the prefrontal cortex as the "organ of civilization"[12] is likely supported by self-control applied in strategic weapon use as it preconditions and reinforces the capacity of intentional delay of gratification.

[4] Cf. Jean Kitahara-Frisch, "The Origin of Secondary Tools," in *The Use of Tools by Human and Non-Human Primates*, ed. by Arlette Berthelet and Jean Chavaillon (Oxford: Clarendon Press, 1993), 239-246.
[5] Cf. Claudio Tennie, Josep Call and Michael Tomasello, "Ratcheting Up the Ratchet: On the Evolution of Cumulative Culture," *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 364 (2009), 2405-15.
[6] Cf. Dieter Claessens, *Das Konkrete und das Abstrakte. Soziologische Skizzen zur Anthropologie* (Frankfurt a.M.: Suhrkamp, 1993), 32-37.
[7] Ibid.
[8] Cf. André Leroi-Gourhan, *Milieu et techniques* (Paris: Albin Michel, 1945), 322.
[9] Arnold Gehlen, *Anthropologische und sozialpsychologische Untersuchungen* (Reinbek: Rowohlt, 1986), 48.
[10] Cf. Davor Löffler, "Abschied der Räume," in Davor Löffler, *Endlichkeitskaskaden. Fünf Aufsätze über den Rand* (Berlin: sine causa, 2009), 29-52.
[11] We are referring here to the distinction between trivial machines and non-trivial or complex machines introduced by Heinz von Förster. Cf. Heinz von Förster, "Principles of Self-Organization in a Socio-Managerial Context," in *Self-Organization and Management of Social Systems*, ed. by Hans Ulrich and Gilbert J. B. Probst (Berlin: Springer, 1984), 2-24.
[12] An expression coined by the psychologist Alexandr Luria. Cf. Elkhonon Goldberg, *The New Executive Brain: Frontal Lobes in a Complex World* (Oxford: Oxford University Press, 2009), 20.

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- Because they neutralize threats, objectify risks and make accessible a wider spectrum of resources, weapons enable forays and migrations into new regions. In this way, weapons increase the possibility of venturing into "outside" environments where new challenges can continue to stimulate the cumulative process of cultural evolution.

- Weapons allow humans to transgress phenotypical limits both to action and strength. Consequently, the use of weapons levels physical differences between members of a collective, changing the fundamental mechanisms by which group hierarchies are formed. This levelling effect has considerable repercussions on the development of status, social roles and self-images.

- Awareness of constant defence-readiness and increased resource security allows for the future to be conceived as an open and projectable continuum of events. Social organization and human cognition are increasingly oriented and directed toward the cultivation and domestication of this open future.[13]

- Increasing dependence on improvements to weaponry leads to the development of more complex devices. Their production requires an increase in the division of labour and an extension of operational chains, resulting in the expansion of individual and collective planning time and an augmentation of instrumental abstraction.[14]

- The organism-weapon assemblage depicted in this coevolutionary tableau contains an implicit "proto-theory" as well as "truth function."[15] In these assemblages, the success or failure of each projected line of attack (obvious in the use of long-range weapons such as spears), and the quantity and quality of strikes, assigns truth value to the entire assemblage, corroborating the theory implied in the function and instrumental causality of the assemblage. Simultaneously, actions sequentially stacked in time, including functional elements aligned with particular instruments, are unified in a single abstract concept of action.

- The training of muscular choreographies bound up with weapon use, as well as the immediate feedback on the usefulness and sense of instrumental behavioural patterns required by specific weapons, stimulates the reflection, refinement and differentiation of the corporeal scheme.

- The strategic and cooperative use of weapons promotes the capacities for social coordination, perspective-taking and linguistic communication.

- The "counter-structure"[16] (*Kontrapunkt*) or "affordance"[17] of weaponry resides not only in the material or organic properties of a given opponent or prey (such as skin thickness or bone hardness), but, more importantly, in its *mental capacities*. In order to be effective, weapon design must anticipate gaps and blind spots in perception, states of consciousness and the responsiveness of opponents - not to mention incorporating the user's own reflection on his/her strengths and weaknesses. Because of this higher order reflection, weapons manifest our capacity to anticipate the operations of other minds, assuming their perspective for motives of offense and defence, and, with this, imply a presumptive knowledge of other minds. The materialization of the psyche through and within the weapon is one of its most important contributions to hominization, cultural and cognitive evolution. The materialization of the limits of awareness and potential reactions of an opponent in weapon production documents the objectification of the noetic sphere, which now becomes a new worldly ontological category.

[13] Cf. Thomas Suddendorf, Donna R. Addis and Michael C. Corballis, "Mental Time Travel and the Shaping of the Human Mind," *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 364 (2009), 1317-24.
[14] See for example Marlize Lombard and Miriam N. Haidle, "Thinking a Bow-and-Arrow: Cognitive Implications of Middle Stone Age Bow and Stone-Tipped Arrow Technology," *Cambridge Journal of Archaeology*, Vol. 22, No. 2 (2012), 237-264.
[15] Cf. Peter Sloterdijk, "Anthropogonischer Exodus," in *Umzug ins Offene*, ed. by Tom Fecht and Dietmar Kamper (Vienna: Springer, 2001), 302-312, 306 (translation by the authors).
[16] Cf. Jakob von Uexküll, *A Foray into the Worlds of Animals and Humans: With a Theory of Meaning*, trans. by Joseph D. O'Neil (Minneapolis, Minnesota and London: University of Minnesota Press, 2010), 139-46.
[17] Cf. James J. Gibson, *The Ecological Approach to Visual Perception* (New York: Taylor and Francis, 1986), 127-143; Alan Costall, "Canonical Affordances in Context," *Avant: Trends in Interdisciplinary Studies*, Vol. 3, No. 2 (2012), 85-93.

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3. Weapons as Motor and Index of Cultural Evolution

Existential conflicts between groups are the ultimate filter for fitness levels of collectives, which mark the degrees of complexity inherent to forms of cooperation, technology and intelligence. Thus, the historical evolution of cultures is mainly mediated by intercultural conflicts in which procedures and technologies of attack and defence are selected.[18] Two general principles play a central role in the process of conflictual or agonistic cultural evolution mediated by weaponry: creative innovation and imitation.

Creativity is the basic ability to create something new, albeit a "new" not created *ex nihilo*. Rather, it grows out of novel combinations of existing knowledge, experiences, practices and structures. It is precisely this associativity that constitutes the special character of human creativity, whereby innovative concepts and procedures often prove to be transferable beyond an original domain of application to other areas.[19] Innovation has three types of causes. It is the result of intentional and specific research in relation to defined needs and purposes ("necessity is the mother of invention"); it is the result of failed efforts that randomly bring forth procedures and applications that can be used in domains other than those intended; finally, it derives from playful experimentation without any clearly defined purpose.[20] Due to existential competition in intercultural conflicts, weapons represent a category of technology in which development is primarily based on intentional modes of innovation.

The hallmark of innovation in weapons technology lies in *the need to anticipate the entirety of properties of prey or adversarial entities*. A bow and arrow, for example, not only reflects the operational, manufacturing and productive capacities of the user and its culture, but, simultaneously, it is also designed in relation to the physical properties and mental capacities of a prey animal as conceived by its developer and user. The same goes for the development of the atomic bomb, which is not only based on the intelligence, knowledge, technology and productive power of entire states, but also anticipates the totality of capacities ascribed to adversaries. Since the construction of weapons is always oriented toward a *construct* of the adversarial entity, and since a weapon is always defined by the context of a specific conflict, any kind of process can be converted into weapons, e.g., trade sanctions, viruses or tapir bones. Understood as such, innovations in weaponry permit noetic objectifications of entities or states seen as in need of being controlled by subjects responsible for producing and using weapons. While animals have a defined set of directly observable, concrete qualities constituting a clear attack surface to which specific weapon technology corresponds, the attack surface of the enemy in the conflict between opposing humans or collectives is always subject to conceptual construction. Regarding human adversaries specifically, this construction must also always take into account the *potentialities* of the enemy to flexibly develop counter-measures. The *anticipatory* and *preemptive modelling* of the opponent's assets is therefore the necessary precondition for the production and use of weapons.

Especially in militant conflicts, a heightened necessity to draw up procedures exceeding the reaction and response capacities of the opponent prevails. But, in the course of this process, the *entirety of available technologies* is transformed and carried beyond the prior state of technological development. This very surpassing of previous states is, in fact, the decisive point for technical and cultural evolution. The existence of weapon technology itself establishes an *existential* need for *constantly adapting* to new levels of technological complexity resulting in a cumulation of capacities. The cumulation of preemptive technologies leads to the formation of a history constituted by layers of ranges of anticipation and preemption that are sequentially and hierarchically encapsulated in each other.[21]

[18] Cf. Heiner Mühlmann, *Nature of Cultures: A Blueprint for a Theory of Cultural Genetics* (Vienna and New York: Springer, 1996), 11-40.
[19] Niels N. Johannsen, "Technological Conceptualization: Cognition on the Shoulders of History," in *The Cognitive Life of Things*, ed. by Lambros Malafouris and Colin Renfrew (Cambridge: McDonald Institute for Archaeological Research, 2010), 59-69.
[20] Cf. George Basalla, *The Evolution of Technology* (Cambridge: Cambridge University Press, 1989).
[21] In the general sense that technology can be defined as storage for triggerable events and any increase of technological complexity can be understood as the condensation or crystallization of time continua containing specific types of triggerable events and causal sequences; cf. Davor Löffler, "Einbruch in die Technosphäre. Skizze eines postanthropischen Technikbegriffs zur weiteren Erkundung der Möglichkeit technogener Nähe," in *"Menschen" formen Menschenformen. Zum technologischen Umbau der* conditio humana, ed. by Bernd Ternes (Berlin: sine causa, 2009), 197-291, 224*ff*. For a detailed explication of the concept of history as a sequence of "layers of preemption and generativity" and its application on cultural evolution and civilizational history, see Davor Löffler, *Generative Realitäten* I. *Die Technologische Zivilisation als neue Achsenzeit und Zivilisationsstufe. Eine Anthropologie des 21. Jahrhunderts* (Wiesbaden: Velbrück Wissenschaft,

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The second principle of technological innovation - imitation - responds to this challenge. In the event of a conflict, it is not only crucial to find new measures of defence against not yet anticipated technologies, and to do so as quickly as possible, but also to emulate advances in weaponry as closely as possible - even to the point of developing counter-innovations - becomes paramount. As advantages in weapon technology amount ultimately to little more than ephemera, an ever-accelerating weapons race, evident at least for all of recorded human history,[22] arises by necessity.

This interplay of innovation and imitation driven by existential stress leads to a certain fateful duality in the features of weapons. While it ensures a degree of safety for its users, and thereby reduces the influence of contingencies in a given environment, the weapon simultaneously generates additional existential dangers and other uncontrollable environmental factors. This duality is the basis of the cumulative and irreversible process of conflict-driven, continuous technological process and, indirectly, cultural evolution.

Thus, weapons technology also indicates stages of civilizational development since it always expresses the quality and structure of developed organizational, technological and cognitive performances; paradoxically, this advanced stage of development is also accompanied by the existential need to innovate, which arises via conflicts initiated by novel weapons. In this cumulative process of enhancement, weapons form the basis and cause of further technological development. Weapons technology, thus, should be regarded as both a motor and index of cultural and social evolution.

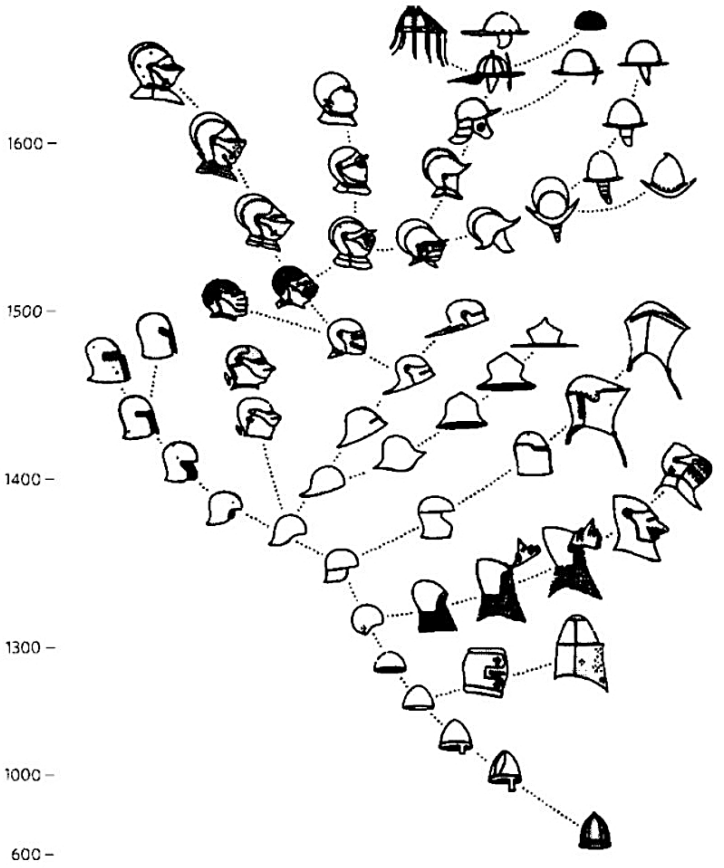

Figure 1. 1000 years of helmet evolution. Source: Kevin Kelly, *What Technology Wants* (New York: Viking 2010), 51; based on Dean Bashford, *Notes on Arms and Armor* (New York: Metropolitan Museum of Art, 1916), 115.

4. Unintended Consequences of Weapons Technology for Society, Culture and Cognition

Alongside intentional projections of environmental mastery, various unintended and unforeseen consequences triggered by developments in weapon technology also inform the process of cultural evolution. Most obvious here are unexpected events and accidents, which can also negatively impact a weapon's user, thus forcing him or her to adopt a reflexive relationship towards his or her own ac-

2019), 204-30.

[22] Cf. Arther Ferrill, *The Origins of War. From the Stone Age to Alexander the Great* (Boulder, Colorado: Westview Press, 1997); Alfred S. Bradford, *With Arrow, Sword and Spear: A History of Warfare in the Ancient World* (Westport and London: Praeger, 2001).

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tions and motives. For example, weapon use can result in tragic malfunctions, friendly fire, or collateral damage. Indirect consequences related to the faulty manufacture or unskilled handling of weapons can also come into question. The development of ABC weapons did not only lead to new types of conflicts and strategies, but also to the formation of the entire areas of science and technology concerned with the elimination of consequential effects (*Folgenbeseitigung*) and remedial control of factors related to inadvertent malfunction or user error.

Yet another unpredictable factor concerns the discovery of new materials, as well as technical, communicative, scientific and organizational procedures, which are applicable to fields beyond original weapon-related domains. The history of urban architecture, for example, clearly demonstrates the close relationship between the form of weapons and human habitat, the immeasurable significance of which for cultural history is exemplified by the Greek acropolis, medieval castles, or cities in the Renaissance.[23] Further examples of this can be found in the way the construction of guns influenced metallurgical advances, which were the basis of Gutenberg's printing press;[24] canons and city defence systems initiated the development of ballistics and structural analysis, which influenced the development of the calculus, and, in general, modern mathematics and physics;[25] modern military drills and chains of command developed in the 17th century, which were transferred into various other domains of society;[26] and the need for devices capable of supporting autonomous steering of air defence systems, which led to the development of cybernetics.[27] In a more contemporary context, the role that ARPANET played as precursor to the internet is echoed today in the development of information technologies, machine learning and AI predominantly financed by the military.[28] The consequences latent to these more recent innovations in weapons technology remain to be seen.[29]

While less conspicuous, the influence of weapons technology on the whole of society, especially on laws and sociopolitical institutions, not to mention norms, virtues and subjectivity, is all the more significant. For example, with the onset of the Enlightenment and the arrival of disciplinary societies, especially following the introduction of firearms, duelling was prohibited, which bore direct consequences on expressions of manhood, status and honour. This also altered the canon of virtues and vice, which shifted from martial aggression, and hotheadedness to sangfroid and "being cool." (Naturally, concepts such as chivalry and courtesy, too, underwent similar transformation.) Closer to our time, nuclear weapons, as well as the need for their strict containment, largely occasioned the development of global ethics and holistic models of morality.

Finally, among the most difficult to identify, yet possessing the greatest import for everyday life, are cognitive schemes and concepts derived from weapon use. Transferred from technological contexts or concrete conflict situations, certain properties of weapons can serve as schemes for structuring assorted cognitive and communicative fields. For example, ancient history shows that the spread of charioteering coincided with new ways for conceptualizing the movement of celestial bodies, transforming the cosmological concepts and metaphysical frameworks of several early cultures.[30] In daily speech, various situations can be grasped figuratively by using metaphors or martial origin, such as "making a breakthrough," "hoisting somebody onto his own petard," "bringing out the big guns" or "close only counts in horseshoes and hand grenades." Such adages help to organize or condense situations noetically and communicate situational nuance.[31]

This brief review of certain unforeseen capabilities resulting from particular innovations in weapons technology points to its singular

[23] Cf. Geoffrey Parker, *The Military Revolution: Military Innovation and the Rise of the West, 1500-1800* (Cambridge: Cambridge University Press, 1988).
[24] Cf. Jarred Diamond, *Guns, Germs and Steel: The Fates of Human Societies* (New York: W. W. Norton and Company, 1999), 159.
[25] Cf. Hans Wußing, *6000 Jahre Mathematik. Eine kulturgeschichtliche Zeitreise.* Band I: *Von den Anfängen bis Leibniz und Newton* (Berlin and Heidelberg: Springer, 2008), 308.
[26] Cf. Michel Foucault, *Discipline and Punish: The Birth of the Prison*, trans. by Alan Sheridan (New York: Vintage Books, 1991).
[27] Cf. Peter Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry*, Vol. 21, No. 1 (1994), 228-266.
[28] Cf. Lars Nielsen, *Computing. A Business History* (Whickford: New Street Communications, 2011), 11-19.
[29] Remarkably, the famous oxymoron uttered by Donald Rumsfeld, Secretary of Defense under George W. Bush, describing national security after the events of 9/11 and concerning the existence of "unknown unknowns," characterizes precisely the beginning of a new culture of preemption, a logic now permeating nearly every aspect of life and society.
[30] Cf. Niels N. Johannsen, "Deus Ex Machina: Technological Experience as a Cognitive Resource in Bronze Age Conceptualizations of Astronomical Phenomena," *Journal of Cognition and Culture*, Vol. 14, No. 5 (2014), 435-448.
[31] Curiously often with a droll undertone.

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role as driver of cultural, technological, cognitive, and moral development. Cultural history is deeply entangled with the direct and indirect effects that weapons technology has on human existence. Highlighting the fulcrum of weapons technology in human history also underlines the need for conscientiously measuring the possible valences unstable technological forces might express in future civilizations.

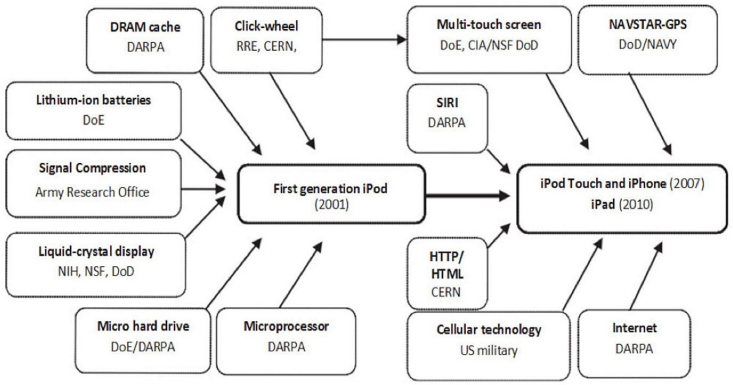

Figure 2. Origins of popular Apple products. Most of the main components used in first developing the iPod, iPhone, and iPad originated in research undertaken by military institutions such as DARPA, the Department of Defence or the CIA. Source: Marianna Mazzucato, *The Entrepreneurial State: Debunking the Public vs. Private Sector Myths* (London: Anthem, 2014), 124.

5. The Weapon as Medium of Ontogenerativity in Cultural Evolution

All technologies are means for domesticating nature and reducing contingency. The specificity of weapon technology is found in its purpose to neutralize particular causes of environmental indeterminacy through creating ordered states, that is, to control autonomous beings and systems capable of complex behaviour, flexible actions, and adaptive reactions. However, with the appearance of armed humans and human collectives, weapons also created a new type of danger and source of contingency. This duality results in a perpetual upgrading and development of weapons, spurred on either by armed conflicts or the threat of them. The existential necessity to anticipate the range of responses, intelligence, and innovative power possessed by opposing individuals and cultures materializes in specific weapon forms, forcing all parties involved to strive for - and perhaps exceed - the same degree of advancement achieved in any given weapon. Since no other durable entity capable of both constant adaptation and learning is able to provide a similar threat to the survival of cultures, weaponized and intelligent entities emerge as the most significant remaining source of selection pressures. As such, they serve as a main cause for development and innovation and key driver of cultural evolution.

If cultural history is understood as the "successor organization to an evolutionary natural history,"[32] weapons then function as the primary medium for the evolutionary pressure deposited into culture as a "second nature." In earlier evolutionary stages, the pressure of natural selection forms phenotypes according to their fitness within ecological niches. In contrast, the evolutionary pressure emerging with culture as a "second nature" selects *cultural behavioural systems,* the fitness of which manifests in the efficiency and utility of noetic concepts; forms of rationality; the ability to plan, to form effective assemblages, to develop productive capacities; and technology. Additional factors, such as the structure of social organization, collective intelligence and techniques for subduing and aligning social forces equally and effectively, also come into play. The influence exerted by weapons in determining the developments in each of these domains unites all elements of cultural evolution.

This uniting principle now can be identified. Simply put, weapons are the materialization of the ability to outsmart other intelligent beings. In weaponized conflicts, depths of foresight are engaged in the struggle against foreign depths of foresight, capacities of anticipation against the opponent's capacity for anticipation, and in the waging of intelligence against intelligence. For this reason, weapons technology acts as a key catalyser for increases in intelligence and foresight, flourishing through the need to model and anticipate capacities held by other intelligent entities. This spiral of preemption most certainly does not lead the participating entities to a purely innocent omega point.[33] On the contrary, the need to intuit

[32] Günter Dux, *Historico-Genetic Theory of Culture: On the Processual Logic of Cultural Change* (Bielefeld: transcript, 2014), 16*f.*

[33] Though, the foreseeability of wars becoming widely automated and algorithmicized (drones against drones, AI against AI) will yield an inevitable increase in and extension of preemptive

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and adapt to an antagonist's intelligence causes the ever-expanding arms races which result in the predominance of the human species on the planet, and soon beyond its boundaries.

This leads us to the conclusion that fronts in active war zones are, in reality, *secondary* to the real fronts on which the preempting of future conflict scenarios takes place, such as in laboratories and along rapidly extending virtual surfaces hosting the projective modelling of the capacities of novel martial entities. The horizon of intelligence, foresight, and preemption is materialized in newly developed technologies, anticipating potential responses and events. Here, where the rendering of potential adversarial entities, events, and causalities through science and technology takes place, is the *actual* war front - and its expansion continues unabated.

Following this logic, the weapon using species appears on the scene accompanied by the emergence of a new evolutionary principle in the cosmos, which is not based solely on selection by fitness based on given abilities, but, rather, by the potential for pre-adaption, foresight, and intelligence, that is by the potential for the development of new abilities. Each newly developed cultural-cognitive form of existence represents a layer of potential foresight and preemptive action serving as the baseline for fresh cultural-cognitive developments. Owing to the fact that this gradual revelation of structures and phenomena predetermines the form, range, and content of human intentionality, decision-making and action, the source of this principle would appear to originate outside of human agency, as it establishes the continua in which relations and agency can concretize.

This generative principle underlying weapon-mediated processes of cultural evolution can be termed *telegenetic preemptivity*. *Telegenetic preemptivity* is constitutional for weapons technology, as for example the history of armour and sword development illustrates. While leather armours may protect against sword blows, armours made of iron may protect against sword blows *and* against arrows. Thus, the range of anticipation and preemption of potential events *embedded* in iron armour is *wider* than that of a leather armour: iron armour, thanks to its material and structural constitution, can preempt more eventualities and events than leather armour as well project deeper and wider zones of safety into the future. The same principle is valid for technologies of assault like swords. For example, a bronze sword may stay intact up to a dozen strikes, while a steel sword may stay intact up to a hundred strikes. The potential future *embedded* in these technologies is, therefore, constituted by a different number of discrete potential events. The number of future events anticipated by an army equipped with steel swords is larger than the number of future events anticipated by the army equipped with bronze swords. The steel-equipped army can envision, integrate, and realize more potential events. It plans and navigates in relation to a deeper and more voluminous future due to the larger number of events that are embedded in its weapons, and it operates based on a projected future in which the rendering of events is more fine-grained. Due to this prospective and simultaneously generative relation to the future materialized in the weapon, the evolution of weapons concretizes a cumulative hierarchy of *telegenetic preemptivity*, providing, in turn, an index of potential telegenesis by which all technologies can be inventoried, measured and compared. For example, due to technological and tactical advantages, only a few hundred conquistadores were able to subdue whole empires in Latin America and, subsequently, the continent itself. [34] In this way, all cultures can in principle be indexed with a value of telegenetic preemptivity and compared by it.

The principle of *telegenetic preemptivity* becomes very concrete in the beginning of the 21st century. Next to the announcement that, under the presidency of Donald Trump, the United States of America will form a space force and by that yet again will expand the frontier of anticipation and preemption, the president of the Russian Federation Vladimir Putin stated in 2017: "Artificial intelligence

capacities. Furthermore, telegenetic efficiency could be gained by the next step of automation consisting in the full virtualization of battle fields, fighting wars in simulations, and predicting the outcome derived from all given parameters. Of course, this speculative scenario would require all participants to agree to the rules of a virtual competition system and accept the outcome of any possible simulations created by this system. Ensuring the authority of this system would necessarily fall on the shoulders of some sort of world government or organizational system, which must not necessarily be based solely on humans. This governmental entity would provide the essential precondition for resolving conflicts virtually and could lead to the ultimate alleviation of the stress of warfare exerted on humans (i.e., the above-mentioned omega-point: "peace on earth"). Given that humans, being biological organisms, remain dependent on and in search of competition for the satisfaction of basic needs such as nutrients, social prestige, and reproductive activity, whether such a system could ever be fully realized remains an open question.

[34] Cf. Felipe Fernández-Armesto and Matthew Restall, *The Conquistadores: A Very Short Introduction* (Oxford: Oxford University Press, 2012), 36-47.

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is the future [...] but for all humankind. [...] Whoever becomes the leader in this sphere will become the ruler of the world."[35] This indicates that the powers of the multipolar world are already starting to erect *algorithmic domes of preemption* of events and potentialities over their spheres of influence and power, establishing a new playing field in which the ever-lasting game of keeping ahead of foreign intelligences will continue in a new round and open new continua of telegenetic emergence.[36]

Although it seems impossible to isolate single causalities and regularities within the coevolutionary processes constituted by complex feedback loops unfolding between various domains, ontologies, and scales of systems, one should not necessarily draw the conclusion that these processes are irregular, aberrant or purely intermittent in nature or structure. The underlying forces bound up in processes of coevolutionary emergence not only act as a motor, but, simultaneously, also as an *inhibitor* of development, as the tendency to preserve ordered states proves (take peace for example). The ability for systems to remain ordered and stable over long periods of time proves that thresholds and parameters of sufficiency exist, thus pointing to the existence of *regular principles* governing forces occasioning development. The then quite literally *regular* structures found in processes of emergence, mediated principally by the capacity for foresight bound up with weapons, makes evident an underlying ontogenerative or "xeno-auto-poietic"[37] structuring force.

In this process of ontogenerativity or "xeno-auto-poiesis" through *telegenetic preemptivity* futurity directly permeates and protrudes into the present. This means that the culture presiding over the most advanced tools for *probing the horizon of potential futures* is the culture in which the "future attractor"[38] is first concretized, residing higher up on the *telegenetic index*. This "xeno-auto-poietic" mechanism driving cultural evolution lies in the unveiling of intelligence, where "future attractors" determine pathways of becoming in the present, opening "cones of realization"[39] that channel the transformation of existing phenomena into new forms, resulting in new objects and relations emerging between them. As generative principles, "xeno-auto-poiesis" and *telegenetic preemptivity* concretized in weapon use condition the formation of noetic milieus in which concrete articulations of mind and culture unfold continuously. In brief, the frontier of the weapon *is* the frontier of onto-poiesis.

In what preceded, we have attempted to outline how the predominance of weapon technology, as a factor of civilizational development, points to an integrative principle catalysing the emergence of all phenomena in cultural evolution. This abbreviated history of weapons reveals the existence of a meta-ontical realm through which forms of existence concretize themselves. The identification and description (*Freistellung*) of this realm may initiate the epistemology of an integrative, posthumanist human science. This new entry point for conceptualizing history will permit future inquiry to specify how motives and forces driving humankind through history, and history through humankind, should be framed and further investigated.

[35] Edoardo Maggio, "Putin Believes That Whatever Country Has the Best AI Will Be 'The Ruler of the World,'" *Business Insider UK* (September 4, 2017). http://www.insider.com/putin-believes-country-with-best-ai-ruler-of-the-world-2017-9

[36] Beyond the "iron cage" (Max Weber) of capitalist production, which commits the global political elite to cling to fossil fuels and petroeconomics despite their being aware of the catastrophic consequences of global warming and the impending collapse, similar actors are obliged to maintain a high-level of telegenetic preemptivity. In this perpetual game of one-upmanship, states cannot afford to risk even a nanosecond delay in the concrete defence actions as well as in "imagineering" of their anticipatory defence responses. This deadlock in the defence systems of global powers arguably factors into global warming and climate change more significantly than any other source. This point is illustrated by the total consumption of fossil fuels and emission of greenhouse gases by the US military, which accounts for up to 30% of the United States' total carbon consumption and carbon emissions; cf. Oliver Belcher, Patrick Bigger, Ben Neimark and Cara Kennelly, "Hidden Carbon Costs of the 'Everywhere War': Logistics, Geopolitical Ecology, and the Carbon Boot-Print of the US Military," *Transactions of the Institute of British Geographers* (June 19, 2019), DOI:10.1111/tran.12319. Solutions to this stalemate are, for a variety of strategic reasons, highly improbable, as replacing defence technologies built with and operated using fossil fuels with sustainably sourced alternatives is not feasible. For example, tanks, fighter jets, and missiles powered with sustainable energy systems cannot compete with those powered by fossil fuel-based systems.

[37] Cf. Hans Peter Weber, *KreaturDenken. Aventüren. Randonné* (Berlin: sine causa, 2006), 86-95.

[38] Ibid., 74 (translation by the authors).

[39] Cf. Löffler, *Generative Realitäten* I (2019), 456-65.

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